Continuing Medical Education Article

The Role of Radionuclide Imaging in Epilepsy, Part 1: Sporadic Temporal and Extratemporal Lobe Epilepsy

Authors
Ajay Kumar and Harry T. Chugani

PET Center, Department of Pediatrics, Neurology, and Radiology, Children’s Hospital of Michigan, Detroit Medical Center, Wayne State University School of Medicine, Detroit, Michigan

Disclosure
In accordance with ACCME Revised Standards for Commercial Support and SNM Conflict-of-Interest Policy, the authors have indicated no relevant relationships that could be perceived as a real or apparent conflict of interest. Disclosure of a relationship is not intended to suggest or to condone bias but is made to provide participants with information that might be of potential importance to their evaluation of the activity.

Target Audience
This article contains information of value to physicians in nuclear medicine, neurologists, and nuclear medicine technologists.

Objectives
On successful completion of this activity, participants should be able to describe…
1. Various radiotracers and radionuclide imaging techniques used in epilepsy evaluation.
2. The role of radionuclide imaging, using PET and SPECT, in the evaluation of patients with temporal and extratemporal lobe epilepsy, particularly in the presurgical localization of the epileptic focus.
3. The contribution of radionuclide imaging in providing useful prognostic information in these patients.

Question 1

What is the most common feature of a medically refractory seizure focus imaged with \(^{18}\text{F}\)-FDG?

A. Interictal metabolic rate equal to contralateral normal cerebral cortex.
B. Ictal metabolic rate equal to contralateral normal cerebral cortex.
C. Interictal metabolic rate lower than contralateral normal cerebral cortex.
D. Ictal metabolic rate lower than contralateral normal cerebral cortex.

**Question 2**

What does comparison of interictal $^{18}\text{F-FDG}$ metabolism with $^{11}\text{C-flumazenil}$ binding to $\gamma$-aminobutyric acid receptors in patients with refractory focal seizures reveal?

A. Spatially concordant reductions in both modalities.
B. Less extensive reductions in $^{11}\text{C-flumazenil}$ than in $^{18}\text{F-FDG}$.
C. Increased $^{11}\text{C-flumazenil}$ in zones of $^{18}\text{F-FDG}$ hypometabolism.
D. Frequent discordant lateralization of abnormalities.

**Question 3**

What is the most common pathology underlying medically refractory seizures originating in the amygdalohippocampal formation?

A. Low-grade astrocytoma.
B. Tuberous sclerosis.
C. Ischemic porencephaly.
D. Mesial temporal sclerosis.

**Question 4**

What is the best predictor of a good epilepsy surgical outcome?

A. Ictal scalp electroencephalography-defined seizure onset zone.
B. MR imaging T2 hyperintensity.
C. Video electroencephalography–defined ictal behavior.
D. Interictal $^{18}\text{F-FDG}$ hypometabolism.
**Question 5**

What is included as an adverse prognostic factors for post–temporal lobectomy seizure control?

A. Severe $^{18}$F-FDG hypometabolism in both the mesial and the lateral temporal lobe.
B. Discordant lateralization of ictal scalp electroencephalography and $^{18}$F-FDG hypometabolism.
C. Bilateral temporal lobe $^{18}$F-FDG hypometabolism.
D. Ipsilateral thalamic $^{18}$F-FDG hypometabolism.

**Question 6**

Among molecular imaging markers studied in refractory epilepsy, which one demonstrates a decreased accumulation in the epileptogenic cortex?

A. $^{11}$C-carfentanil.
B. $^{18}$F-fallypride.
C. $^{11}$C-PBR28.
D. $^{11}$C-deprenyl

**Question 7**

In what setting do ictal/interictal SPECT perfusion studies have the greatest advantage over interictal $^{18}$F-FDG PET for presurgical epilepsy evaluation?

A. Normal proton MR imaging findings, including fluid-attenuated inversion recovery and diffusion-weighted sequences.
B. Nonlocalizing ictal scalp electroencephalography evaluation.
C. Persistent seizures after previous epilepsy surgery.
D. Discordant ictal electroencephalography and MRI results.

**Question 8**

When is the best time to inject the tracer for ictal SPECT perfusion imaging?
A. Immediately before seizure onset.
B. As soon as possible after seizure onset.
C. When the seizure is fully developed.
D. During the early postictal phase.

**Question 9**

What is the most common cause of refractory focal neocortical epilepsy?

A. Viral and postviral encephalitis.
B. Developmental neuronal migration abnormality.
C. Inborn errors of amino acid metabolism.
D. Tuberous sclerosis.

**Question 10**

What is the most likely etiology for $^{18}$F-FDG hypometabolism in the amygdalohippocampal formation in patients with underlying mesial temporal sclerosis?

A. Increased inhibitory neurotransmission.
B. Increased astrocyte metabolism of fatty acids.
C. Metabolic effect of blood–brain barrier breakdown.
D. Reduced volume of synaptic neuropil.